Series 1930 Number 22

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Survey

of

Benewah County, Idaho

By

E. N. POULSON
United States Department of Agriculture, in Charge

and

K. B. PLATT
University of Idaho

Bureau of Chemistry and Soils

In cooperation with the
University of Idaho, College of Agriculture
and Agricultural Experiment Station

For sale by the Superintendent of Documents, Washington, D.C. - - - - - - - - - Price 45 cents

BUREAU OF CHEMISTRY AND SOILS

HENRY G. KNIGHT, *Chief*
A. G. McCALL, *Chief, Soil Investigations*
SYDNEY FRISSELL, *Editor in Chief*

SOIL SURVEY

CURTIS F. MARBUT, *in Charge*
M. H. LAPHAM, *Inspector, District 5*
J. W. McKERICHER, *in Charge Map Drafting*

COOPERATION

UNIVERSITY OF IDAHO
COLLEGE OF AGRICULTURE AND AGRICULTURAL EXPERIMENT STATION

E. J. IDDINGS, *Dean and Director*
G. R. McDOLE, *in Charge Soil Survey*

CONTENTS

SOIL SURVEY OF BENEWAH COUNTY, IDAHO

By E. N. POULSON, United States Department of Agriculture, in Charge, and K. B. PLATT, University of Idaho

COUNTY SURVEYED

Benewah County lies in the west-central part of the "Panhandle" of Idaho. The western boundary is formed by the Idaho-Washington interstate boundary line (fig. 1). The county comprises an area of 786 square miles, or 503,040 acres. This includes about 2½ square miles of water surface and more than 100 square miles of land in national forests and State parks. St. Maries, the county seat, is about 65 miles southeast of Spokane, Wash.

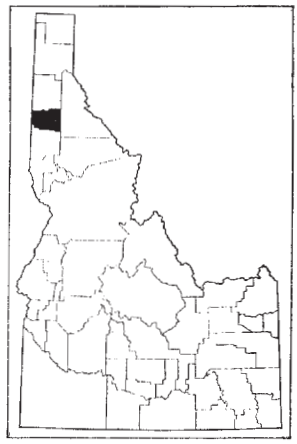


FIGURE 1.—Sketch map showing location of Benewah County, Idaho.

The land surface is in general rough, consisting principally of a forested mountainous or semimountainous terrain, with comparatively narrow valleys which open out to the west, culminating in the rolling and hilly prairie region of the "Palouse country." Prominent physiographic features have been determined by the invasion of the Columbia lava flow from the west into a region of eroded valleys. This flow spreads tonguelike into the various valleys, causing embayments of the western lava plateau. Established valleys were deeply buried, but drainage became practically readjusted to the old courses because of the old mountain ridges.

The stream courses evidently became reestablished rapidly, and very little coarse stony old valley-filling material was deposited over the basalt which retains a terracelike, or benchlike, relief. The streams cut narrow incised valleys and canyons, with steep precipitous walls and talus slopes, in the basalt. The maximum depth of cutting and steepness of gradient established by the major streams is in evidence along St. Maries River only, because of ice invasion and morainic deposition to the northwest, outside the county, which obstructed drainage, causing development of lakes in the obstructed valleys, of which Coeur d'Alene and Chatcolet are the largest representatives. The lake area now is small within Benewah County because of deltalike silting of St. Joe River and part of St. Maries River, which has built up a semiswampy or marshy lowland belt, slightly higher than the lake level, through which these streams, confined by natural and artificial levees, pursue sluggish winding courses.

41684—35——1

The lowest point in the county is the level of the lakes, 2,124 feet above sea level. The highest elevations are in the northeast and east sections, where some of the mountains rise to heights of more than 5,000 feet. Intermediate elevations are best expressed in relation to the lava flow which has an average elevation of 2,600 feet in the western prairie section, rising to a maximum of about 3,000 feet. This basalt plateau is almost continuous along the western edge of the county but is separated from the plateau in the eastern part by a low smoothly rounded chain of mountains extending in a northwesterly direction. This ridge and another along the southern boundary divide the principal watershed into that draining west into Latah Creek and that draining northwest into Coeur d'Alene Lake. Excepting the deep trench of St. Joe River, the eastern part of the county is almost completely enclosed by steeply rising mountains. The area between this high territory and the ridges on the west and south is a smoothly rounded terrain of low mountains ramified by a dendritic drainage system, in which the principal valleys with basalt terraces are developed along St. Maries River, Santa Creek, and Benewah Creek. Very little agricultural land lies higher than a few hundred feet above these terraces.

The deeply entrenched St. Joe River enters the county at an elevation of 2,733 feet, only a few feet higher than that where it flows into the lakes. The lower course of St. Maries River is of similar character, but the flat area culminates in an incised canyon about 8 miles upstream, to which point the river drops about 50 feet to the mile from the vicinity of Santa, where the elevation is 2,678 feet above sea level. Above Santa the drop is less pronounced, and valleys are developed. Many of the tributary streams drop through incised basalt canyons to the low bottoms, some of them as much as 500 feet within only a few miles.

Except in the extreme western part, streams in the prairie section have not cut into the underlying basalt. This retarded cutting has resulted in the formation of wide alluvial flats along the major stream courses, through which streams are now cutting deeper channels. These flats are moderately well drained.

The western part of the county, including about 11 percent of the entire area, lies within the open prairie of the "Palouse country." Here the original vegetation consisted of rank bunch grasses, with scattered growths of wild rose and snowberry. The stream bottoms supported growths of willow, alder, and other brush and bushes.

The remainder of the county is forested with conifers. Originally it was almost continuously timbered, with the exception of areas of wet bottoms along streams, which supported water-loving grasses, willow, alder, and other brush growth, and occasional cottonwoods. The conifers included western yellow pine, western white pine, lodgepole pine, white fir, red fir, cedar, tamarack, spruce, and hemlock. Where the prairie merges with the forest there is a narrow parklike belt of yellow pine and lodgepole pine, with deciduous underbrush, mostly wild rose and snowberry. The stand of timber increases in volume as the elevation increases toward the east, and here there is

very little underbrush except on burned-over and logged areas. On the burned areas the first permanent growth is willow. Much of the forested section, except that held as national forest, has been logged within the last 30 years and is now in second-growth timber of species similar to the original.

Settlement in Benewah County began with the arrival of the Catholic missionaries in St. Joe River Valley in 1846 and at Desmet in the western section in 1877. The work of the missionaries was mainly with the Indians and did not effect immediate settlement. About one-half the county was held within the Coeur d'Alene Indian Reservation until 1910. The rich prairie lands were thus kept from settlement until that time, and major activities were centered in the timbered section.

Though there were some early settlers in the meadows along the streams, the main influx of people did not begin until about 1900, when it become possible to acquire land as timber claims. Lumbering then became an important industry, and settlement in relation to this industry became accentuated.

Since the opening of the Coeur d'Alene Indian Reservation, settlement in this section has been comparatively rapid. The population now consists of both Indians and whites. The Indians rent their holdings to the whites and reside chiefly at the Desmet Mission. The rest of the white population resides mainly in the towns, villages, and lumber camps. Some live on scattered farms throughout the timbered section. The county was not organized until 1915, and in 1930 the population was 6,371.

St. Maries is the largest town. Other towns and villages are Plummer, St. Joe, Emida, Santa, Fernwood, Tensed, and Sanders. Their population has fluctuated with the lumbering industry.

Transportation facilities are supplied by railroad, water, and highway. The Chicago, Milwaukee, St. Paul & Pacific Railroad serves the northern and eastern parts of the county. The Oregon-Washington Railroad & Navigation Co. (part of the Union Pacific system) traverses the northwestern section. Branch logging railroads penetrate many parts of the timber section. River boats navigate St. Joe River as far as St. Maries, and regular launch and steamer service is maintained between St. Maries and the city of Coeur d'Alene and intermediate points.

Graded roads, many built principally for logging, extend along the principal streams in the forest section. Many of these are now in a poor state of repair. A Federal-aid highway extends south from St. Maries, through Emida, to the southern part of the county. A similar highway runs north and south through Plummer. The roads in the prairie section are few, and most of them are not hard surfaced.

All the towns have good school facilities, and outlying sections are well supplied with district schools. High schools are located at St. Maries and Plummer. The Catholic Mission at Desmet provides educational advantages for the Indians.

Lumbering continues to be a very important industry, and sawmills are operating at St. Maries and Fernwood.

CLIMATE

Benewah County lies in the continental interior, where climatic factors are influenced and modified by the Cascade Mountains on the west and the Coeur d'Alene and Bitter Root Ranges of the Rocky Mountains on the east. Lying in the outer mountain ridges and hills of the latter range, on the westward-facing slope, the county is subjected, by westerly winds blowing from the Pacific Ocean, to a precipitation which varies from 20 inches in the western prairie section to nearly 40 inches in the more elevated mountainous eastern section.

The increase in elevation toward the east plays an equally important part in temperature, causing a variability from west to east. In relation to frost, this is of greatest importance in determining the growing period for crops. The prairie section has the longest growing season, probably about 5 months. The physiographic irregularities to the east cause differences which are not in accord with the general rise in elevation, so that figures for any one place cannot be interpreted as representative of an extensive section. The average frost-free period at St. Maries is 127 days, but in the valleys to the east it is shorter.

The moderating influence of the warm winds from the coast and the protection from the cold northerly winds, afforded by the Rocky Mountains, are important factors in stabilizing the seasonal variations. However, there are periods of high summer temperature and low drops in winter, but these are of comparatively short duration. The mean annual temperature at St. Maries is 47.2° F.

The prevailing winds are from the southwest. They never attain high velocities, but dust storms are frequent during the spring.

The precipitation occurs mainly from September through June. The peak occurs during November, December, and January, principally as snow, of which an average of 54.6 inches falls annually at St. Maries. The driest months are July and August. The moisture distribution is especially conducive to the growing and harvesting of winter wheat.

Table 1, compiled from records of the Weather Bureau station at St. Maries, sets forth the more important climatic data for the agricultural section of Benewah County.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at St. Maries, Benewah County, Idaho*

[Elevation, 2,155 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1928)	Total amount for the wettest year (1927)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	30.3	64	−24	3.50	2.04	4.81	11.0
January	28.1	59	−22	3.27	2.85	3.34	17.3
February	32.4	67	−26	2.37	.24	3.80	12.3
Winter	30.3	67	−26	9.14	5.13	11.95	40.6
March	39.3	74	−3	2.64	2.62	1.88	7.4
April	46.9	92	19	1.66	1.10	1.11	.3
May	54.1	92	25	2.07	.59	1.88	(1)
Spring	46.8	92	−3	6.37	4.31	4.87	7.7
June	61.0	100	29	1.44	.33	2.43	(1)
July	66.7	106	36	.77	.20	.17	0
August	65.1	101	31	.82	.17	.98	0
Summer	64.3	106	29	3.03	.70	3.58	(1)
September	56.8	96	25	1.27	.30	4.88	(1)
October	48.1	86	13	2.00	1.41	4.00	(1)
November	37.5	73	−8	3.63	1.90	6.73	6.3
Fall	47.5	96	−8	6.90	3.61	15.61	6.3
Year	47.2	106	−26	25.44	13.75	36.01	54.6

[1] Trace.

AGRICULTURE

Between the time of the coming of the missionaries and the opening of the timber claims in 1900, a few ranches were established along the stream meadows, where cultivation was easy and where sufficient pasture and hay for livestock was available. After 1900, logging became the important industry, and the self-sufficing type of agriculture expanded somewhat to include supplying some necessities to the people of the towns and of the lumber camps. The wheat-producing prairie section was withheld from settlement until 1910. Therefore that section was only a small factor in the agriculture of the county until that time.

By 1920, according to the census, 23.6 percent of the county was held as farms, though only 38 percent of this was classed as improved land. Ten years later the census shows an increase to 25 percent in farm acreage and an increase to 43 percent in the part improved, that is, used for crops and plowable pasture.

Table 2 gives the acreage and production of the principal crops in 1919, 1924, and 1929.

TABLE 2.—*Acreage and production of principal crops in Benewah County, Idaho, in 1919, 1924, and 1929*

Crop	1919		1924		1929	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Wheat	18,931	359,405	12,722	214,830	22,549	561,729
Oats	4,029	107,173	2,666	56,240	2,431	88,391
Barley	56	934	359	5,799	750	20,989
Dry peas	517	5,051			1,700	21,815
Potatoes	425	31,557	308	25,027	509	37,003
		Tons		*Tons*		*Tons*
All hay	10,852	11,331	10,419	11,322	10,858	13,452
Alfalfa	201	93	422		1,249	1,455
Timothy	2,843	2,567	3,836			
Clover	110	174	129		146	168
Timothy and clover, mixed	986	1,362	2,205		[1] 4,878	[1] 6,055
Wild hay	942	1,276	800		446	489
Grains cut green	5,497	5,490	2,852		4,047	5,148

[1] Includes some timothy sown alone.

From table 2 it will be seen that wheat is and has been the leading crop grown, with hay holding second place. The hay crop consists mostly of timothy, timothy and clover mixed, and grains cut green. Alfalfa is increasing in importance.

The number of livestock is small. On April 1, 1930, there were on the farms of Benewah County, 1,958 horses, 85 mules, 4,335 cattle, 1,946 swine, 572 sheep, 69 goats, and 18,842 chickens.

Commercial fertilizers are used to a very small extent, only 2.2 percent of the farmers making such applications.

The wheat farmers employ most of the hired labor, and the usual wage for unskilled labor is $2.50 a day.

The average size of farms increased from 207.1 acres in 1920 to 235.5 acres in 1930. The greater number of farms are between 100 and 174 acres in size. There are two farms containing less than 3 acres and one including more than 5,000 acres. The smallest farms are in the St. Joe River bottoms near St. Maries, the largest in the Palouse wheat country, where large investment in labor-saving machinery makes large holdings preferable.

Owners operated 73.4 percent of the farms in 1930, tenants, 24.9 percent, and managers, 1.7 percent. Part-crop rental is the basis for most of the land leases.

In 1930 the farm investment was divided as follows: 72.8 percent in land, 14.3 percent in buildings, 6.8 percent in implements, and 6.1 percent in livestock. The average acre-value of farm land (including buildings) was $40.63.

In the Palouse country, farm buildings are for the most part in a poor state of repair or entirely lacking, as much of the land is rented from the Indians. Large investments are made in farm machinery and tools, as these are essential in wheat farming. Much of the work is done by tractors. The horses and mules are large and well kept. Little attention is given to the character and breeds of other livestock, as this is essentially a wheat country.

In the timbered sections most of the farmhouses are built of logs, and much less is invested in work animals and farm machinery. However, the tendency is toward increased interest in livestock improvement.

As has been noted, in the prairie section where dark soils prevail, the primary interest is the production of wheat. There is a very limited production of forage and feed grains, and the agricultural industries that become associated with a diversified type of agriculture are totally subordinated. They are developed only to the extent of partly supplying the farm needs.

The wheat is sold as a cash crop to local elevators which, in turn, sell to Pacific-coast, Midwest, and Eastern markets. The peas grown are used for seed by Midwest canneries.

In the rest of the county, which includes the light-colored forest soils and associated bottom lands, the farm crops are best marketed as livestock products, and diversification of agricultural industries commands more attention. On the cut-over land, the dairy industry seems to be the most promising. This centers around alfalfa as a hay crop and sweetclover as a pasture crop. Small flocks of sheep or some hogs and poultry are kept on the dairy farms. Beef cattle are produced to less extent than dairy cattle.

On the St. Joe bottoms, dairying is of primary importance, with beef-cattle and poultry raising developed to less extent. The dairy products are consumed locally in the towns and logging camps and to some extent are shipped to nearby cities. Beef cattle, sheep, and hogs find a market locally, and some are shipped to the Pacific coast and Midwest markets.

In agricultural development and the methods and management of the different soil groups, Benewah County may be divided into three distinct divisions locally designated as the Palouse country, cut-over lands, and St. Joe bottoms.[1]

The agriculture of the entire Palouse country is built around wheat. On part of the ranches wheat is grown on half the land, and the other half is summer-fallowed. This practice developed as yields began to decline under the continuous cropping system. In recent years peas have been used to alternate with wheat in place of summer-fallow. The yields of wheat after peas have been so near those obtained after fallow that the system of peas and wheat production has proved much more profitable than that of wheat and summer-fallow.

Winter wheat yields more than spring wheat and is generally planted, except when the season is such as to prevent fall sowing. The more common varieties are Fortyfold and Albit, but Triplet, Bluestem, hybrid clubs, and Red Russian are also grown. Spring varieties are Marquis, Federation, and Baart. Peas are of the Alaska variety.

Grimm is the dominant variety of alfalfa grown, since, because of winter conditions, this variety is safer to grow than the Common. Alfalfa requires some form of sulphur added to the soil, and gypsum has proved a desirable carrier of this element. It is applied at the rate of about 200 pounds to the acre every third year. The biennial white sweetclover is most commonly sown.

Oats are of the Markton variety, and barley of the Winter Club and Trebi varieties. The principal variety of potatoes is Netted

[1] Material for this discussion was supplied by G. R. McDole of the University of Idaho Agricultural Experiment Station.

Gem, and some Idaho Rural, Bliss Triumph, and Early Ohio are grown.

The Palouse country is in need of greater diversification of crops, the use of more legumes, and a more definite crop rotation. Commercial fertilizers have failed to show profitable increases. Nitrogen is the most needed element in most places, and this can best be obtained through the use of more legumes. For more detailed discussions on agricultural management, University of Idaho Experiment Station Bulletins 136 and 158 may be consulted.

The cut-over lands are low in nitrogen and organic matter. The unfavorable residue from conifers disappears through proper clearing and the use of sweetclover in the cropping system. Sulphur has proved to be the only mineral nutrient that can be profitably added to these soils. Although the soils are slightly acid, few of them respond profitably to the addition of lime.

The farming problem has been solved fairly satisfactorily by working out the details of the fertility problems and methods needed to obtain stands of legumes. Alfalfa and sweetclover have proved adapted to most of the cut-over sections of northern Idaho. Gypsum has produced an average increase in the yield of alfalfa of 1 ton an acre. The rotations used are based on these two legumes or clover. The main crops used in the rotations are grains and potatoes. Wheat in this section cannot compete with that grown in the prairie section because of the small size of the fields. It is possible to build up these soils by the use of legumes in well-selected rotations and thus increase yields from 15 to 25 percent.

On the diked soils of the St. Joe bottoms, which constitute the best developed part of the bottom soils, clover hays, either alsike or red clover, have proved more dependable than timothy. In addition they keep up the fertility of the land. Gypsum or sulphur in some form increases the yield of clover materially, and lime has proved beneficial in a few places. Commercial fertilizers have not proved profitable except as a carrier of nitrogen, and it is questionable whether nitrogen cannot be obtained more profitably through the use of a legume in the rotation. Such a rotation would tend to increase and stabilize the yearly average production of the main cash crops—oats, potatoes, vegetables, and truck crops.

SOILS AND CROPS[2]

The uniformity of characteristics of the various soil groups and their marked collective zonal distribution are a definite feature in Benewah County. These factors have been of major influence in the development of the agriculture.

There are two major divisions of soils easily recognizable because of differences in characteristics. These are the dark-colored upland soils, which were originally grass covered, and the light-colored soils of the forest, with a conifer tree cover. Within these broad groups are the subgroups of soils which differ in minor character-

[2] In comparing the soil map of this survey with those of adjoining surveys, conflicts in classification and mapping of certain of the soil types and phases will be observed. These are further noted and explained in the section on Soils and Their Interpretation, which follows later in this report, to which the attention of the more critical and technical reader is invited.

istics originating in differences of the underlying rock, in relief, and in drainage.

Throughout the period of soil formation and development certain characteristics have become impressed on the soils by the vegetal cover. The dark-colored upland soils are very dark because of the accumulated organic matter under a grass cover. The forest soils are light colored because very little organic accumulation takes place under conifer tree growth. Indirectly these color characteristics are related to the rainfall and physiography because of the influence these factors bear on the vegetal cover.

The soils of each of these two major groups occupy a definite part of the county. The dark-colored soils occupy an area of rolling prairie in the western part, with a total area of about 77.5 square miles. The light-colored soils occupy most of the rest of the county, consisting of more elevated territory of low-lying hills and mountains, interspersed with valleys.

Practically all the area occupied by the dark-colored soils is cultivated, but only a small part of the area covered by light-colored soils is farmed. About 500 square miles of the latter soils have a rough mountainous terrain practically unsuited for any form of agriculture except grazing. The future of this territory depends almost totally on the timber growth. More than 100 square miles of it are held within the St. Joe National Forest and Heyburn (State) Park.

In the following pages the different soils of Benewah County are described in detail, and their agricultural possibilities are discussed. The accompanying soil map shows their distribution, and table 3 gives their acreage and proportionate extent.

TABLE 3.—*Acreage and proportionate extent of soils mapped in Benewah County, Idaho*

Type of soil	Acres	Per-cent	Type of soil	Acres	Per-cent
Palouse silt loam	26,496	5.3	Chamokane loam, light-colored phase	3,968	0.8
Palouse silt loam, terrace phase	2,432	.5	St. Joe very fine sandy loam	3,584	.7
Nez Perce silt loam	6,144	1.2	St. Joe fine sandy loam	3,264	.6
Latah silty clay loam	14,528	2.9	St. Joe loam	576	.1
Santa silt loam	48,896	9.7	Colville silty clay	3,008	.6
Santa silt loam, outwash phase	2,304	.5	Potlatch loam	3,584	.7
Benewah silt loam	36,416	7.2	Chamokane loam	768	.2
Huckleberry silt loam	4,160	.8	Peat	2,112	.4
Huckleberry silt loam, red-subsoil phase	4,736	1.0	Rough mountainous land	319,424	63.5
Underwood silt loam	8,576	1.7	Scab land	1,472	.3
Peone silt loam	6,592	1.3	Total	503,040	

DARK-COLORED UPLAND SOILS

The dark-colored upland soils are developed on material which has great uniformity of texture throughout its extent. The thickness of the parent material is variable, but the material is known to cover the basalt substratum to extreme depths ranging from 150 to 200 feet. In only a few places have the streams eroded this material to the basalt. It is generally conceded to be of wind-laid origin.

Having developed under grass cover, the dark-colored upland soils have certain inherent characteristics therefrom. They are dark because of the high organic-matter content developed from the grassland vegetation. They are fertile because of this organic matter and because the grass cover has retarded and counteracted excessive leaching and erosion.

The silty character of the parent material and the abundant organic matter have been conducive to the development of favorable texture, excellent soil structure, and good moisture-retaining properties.

The same climatic environment that has been natural or ideal for grass development obviously still obtains. Naturally any economic plants that best fit into this climatic and soil environment are the ideal crops for this prairie country. The grain crops fit this environment because they are grass plants. There has been little conflict between these natural environmental factors and crop selection. Most of the farmers who settled the prairie Palouse country knew of the potential possibilities of the grasslands for grains from experiences in the Middle West, others naturally fell in line.

These soils were easily put under cultivation. There were no serious obstacles in soil or surface relief to curtail extensive and continuous farm developments. Holdings became large or were operated by large-scale methods, and farming practices absorbed and kept progress with new developments in farm machinery, dominated in recent years by the combine harvester.

The conditions of soil and climate have been the underlying forces that have made this land a winter-wheat producing section. Wheat is the greatest commercial crop of the small grains and the most readily marketed. Winter wheat yields more than spring wheat. The summer-fallow method for conservation of moisture fits in with the production of winter wheat. The main precipitation period from September through June makes long growing and maturing seasons for wheat, and the snow cover affords good protection for the plants. The dry months of July and August are ideal for harvesting.

Under the continuous production of this one crop, yields are diminishing. Loss of organic matter leaves the soil subject to more active erosion, and moisture retention is impaired (pl. 1).

Some progress has been made by enterprising farmers in checking or restoring this depletion, but in general these facts are ignored. The use of peas in place of summer-fallow seems to maintain average wheat yields, and an additional revenue is obtained from the peas. The use of alfalfa and sweetclover in the crop rotation proves beneficial in soil improvement. Such forage crops necessarily call for a readjustment in agricultural practices. Especially will this involve livestock industries which have not been developed because of the dominance of wheat growing. When economic pressure and fertility problems become sufficiently serious the agriculture can adjust itself, because the range of crop selection in this county is not necessarily limited.[3]

These dark-colored soils include Palouse silt loam, Palouse silt loam, terrace phase, Nez Perce silt loam, and Latah silty clay loam.

[3] SEVERANCE, G., HUNTER, B., and EKE, P. FARMING SYSTEMS FOR EASTERN WASHINGTON AND NORTHERN IDAHO. Idaho Agr. Expt. Sta. Bull. 173, 83 pp., illus. 1930.

The Palouse and the Nez Perce soils occupy upland areas and the Latah soil the valleys.

Palouse silt loam.—Palouse silt loam is the most important dark-colored upland soil in the county. It is developed on loessial or wind-laid material and has a rolling or hilly relief. It is ramified by a well-developed dendritic drainage system and therefore is well drained. The moisture-retaining properties are excellent. Some of the steeper slopes are subject to severe sheet erosion and gullying.

The surface soil is dark dull-brown or dark grayish-brown mellow friable silt loam to a depth of about 10 inches. Beneath is a 10-inch subsurface layer of dull color but not quite so dark as the surface soil. The texture is slightly heavier, but the soil is friable and crumbly. The underlying subsoil presents three distinct divisions in which the upper part, between depths of 20 and 40 inches, is dull rich-brown clay loam with slight grayish-white mottlings. From a depth of 40 to a depth of 60 inches the subsoil becomes reddish-brown or yellowish-brown clay loam with increased mottling. The material in both these horizons breaks into elongated vertical or columnar masses after exposure. The deeper material is yellowish-brown or tawny-yellow clay loam which continues to the basalt substratum.

This soil has incorporated a large quantity of organic matter from the grass cover. It is but moderately leached and contains a good supply of plant nutrients. These characteristics, together with the silt loam texture and ideal structure, make it a high producing soil. Its chemical reaction is nearly neutral.

Though only 41.4 square miles in the county consist of this soil, it constitutes the main body of the dark-colored soils, on which the wheat crop is produced. Practically all the land is farmed. The average yield of winter wheat is about 35 bushels an acre, but under favorable conditions 40 or more bushels are reported. Spring wheat averages about 25 bushels an acre and is usually planted only when seasonal conditions are such as to interfere with the normal cultivation and planting of winter wheat.

Peas are grown by some farmers as a substitute for summer-fallow. They produce about 25 bushels to the acre.

Less acreage is devoted to oats than formerly, owing to the general substitution of tractors for horses. Yields of oats range from 35 to 50 bushels an acre, and barley yields are about the same.

Alfalfa is grown on a very small area. Yields vary greatly, but they usually range between 1 and 2 tons an acre.

Potatoes are grown as a cash crop by a few farmers. The general practice is to use them as a substitute for summer-fallow. Average yields range from fifty to eighty 100-pound sacks to the acre.[4]

The steeper hillsides occupied by this soil are subject to destructive erosion, mainly of the sheet-erosion type, but this is not fully appreciated, the process being of subtle and inconspicuous development, though barren and fallow surfaces are sometimes scored by incipient gullies during periods of heavy rainfall. With renewal of cultural operations incident to the type of grain farming to which the soil is devoted, the gullies are smoothed over, filled, and obscured. The result, however, is a gradual removal of the dark-colored surface

[4] Crop figures in this report are supplied in part by the county agricultural extension agent.

soil down the hill slopes, and the development of a shallow surface soil and exposure of the brown heavy-textured less productive subsoil layers locally known as "clay points" on the steeper and higher spots. This problem of erosion on the Palouse soils, with methods of control, is now being studied critically at the Pacific Northwest Soil Erosion Experiment Station conducted by the Bureau of Chemistry and Soils and the Bureau of Agricultural Engineering of the United States Department of Agriculture, in cooperation with the Washington Agricultural Experiment Station, at Pullman, Wash.

Palouse silt loam, terrace phase.—Differentiation of the terrace phase of Palouse silt loam, as its name indicates, is based chiefly on difference in topographic occurrence. This soil has a total area of only 3.8 square miles and lies in narrow belts along the major stream courses, transitional with the Latah soil. In most places, the color of the surface soil is darker than that of typical Palouse silt loam, and the subsoil may have a duller color, especially in depressed areas.

Crops and yields are similar to those on the typical soil.

Nez Perce silt loam.—Nez Perce silt loam occupies an area of 9.6 square miles. It is continuous with Palouse silt loam, lying in a narrow transitional zone between the prairie and the forest soils. It includes both prairie areas and open parklike areas covered with yellow pine and a grass and deciduous-brush undergrowth. Probably about one half of this soil is farmed. The timbered area is being slowly cleared and added to the agricultural soil.

The surface relief is in general less rolling than that of Palouse silt loam, especially where the soil penetrates into the forest section along the major streams. This is a well-drained soil.

Lying in a transitional vegetative zone, the color of the surface soil is necessarily variable, ranging from very dark dull brown to grayish brown. The chief difference from Palouse silt loam is the development of a grayish-white silty highly siliceous layer about 4 inches thick, at a depth of about 30 inches. Below this the subsoil is dull reddish-brown clay loam or clay, which is very tough and compact but which lacks the white mottling occurring in the typical soil.

Crop yields and agricultural practices are similar to those on Palouse silt loam.

Latah silty clay loam.—Latah silty clay loam occupies an aggregate area of 22.7 square miles. It is easily recognized as the dark soil which lies in continuous areas along the major streams and tributaries in the prairie section, extending into the timbered section where either a prairie or a heavy deciduous-brush vegetation may grow.

Intermittently this soil is subjected to excessive moisture as a result of the run-off from the higher lying adjacent soils and of the early spring flood waters from the higher lying mountainous territory. The gradient of the streams is slight, hence the stream channels meander, and many of them break into several courses. However, they are cut sufficiently deep to carry off the water except during floods. This soil remains wet late in the spring.

Its low-lying position and retarded wet condition has left definite impressions on this soil which is decidedly darker and more gray than the adjacent upland soil. High amounts of organic matter have accumulated from the heavy grass and brush covering. Additional

organic matter and dark soil material, also mineral plant nutrients, have been carried in from the upland. It is a fertile high-producing soil and is extensively farmed in conjunction with the dark-colored upland soils, except where it is cut up or isolated by channels or escarpments. In such places it is used for pasture. The chemical reaction ranges from neutral to very slightly acid.

In typical development this soil has a friable very dark grayish-brown or grayish-black silty clay loam surface soil to a depth of about 10 inches. The succeeding 10 inches consists of appreciably grayer and somewhat more compact material of silty clay loam texture. At a depth ranging from about 20 to 26 inches there is a distinct layer of very light gray siliceous silt loam with a high content of very fine sand. The upper subsoil layer is fractured heavy clay loam or clay, in which the color is obscured by a brown and black coating on the breakage planes. The coating becomes less pronounced with depth, and at a depth of about 46 inches the subsoil material becomes drab or yellowish-gray clay loam mottled with iron stains (pl. 2, *A*).

Though this description is typical of the average profile, there are places in which the soil has been disturbed by channeling and deposition. In such places the profile is less definitely developed.

In general, yields on this soil are a little higher than on Palouse silt loam. When oats or barley are grown the Latah soil is favored, as these crops can be planted later than wheat.

LIGHT-COLORED FOREST SOILS

Throughout the region of light-colored forest soils are a number of soils that have accumulated or developed in the immediate stream bottoms. These have definite characteristics which distinguish them from the upland soils, but as an economic unit they can be discussed together.

Such agricultural development as has taken place in the forest section has been distinctly different from that of the prairie, and the early development is still reflected in the present agriculture.

The pioneers settled along the streams where meadows were found. These soils were more fertile than the upland soils and easy to clear of deciduous brush. The settlers had no designs on the timber wealth, and they established a self-sufficing type of agriculture. Timothy was grown extensively to supplement the wild-meadow hay and pasture.

The influx of homesteaders on timber claims, in about 1900, added a new development in the county. These people settled indiscriminately on widely different soils, their primary interest being in the timber. They usually cleared only a few acres, in order to supply a part of their farm needs. Their chief income was from logging their own land or being similarly employed by others.

Lumbering became the chief industry in this section. Any surplus farm products, including timothy hay, found a ready market in sawmill towns and logging camps. To that extent the agricultural industry became stimulated, and some further expansion into the timbered area took place as the lands became logged off. Ease of clearing was generally paramount to that of soil factors in farm

locations. Much land unsuited for agriculture was cleared, and some excellent farm land was also obtained.

Most of the men who cleared these lands were not farmers but men who had spent their time in the woods. Crop yields were disappointing, owing to inexperience of the settlers, the poor choice of soils, and the natural deficiencies and resinous toxicity of the land. Some abandonment took place, but often lands were sold cheaply to others who added cleared land to the farm unit, while they were supported principally by logging, and in their spare time logging did not conflict with farm labor. Land often passed through the hands of several holders before sufficient was cleared of timber to constitute a farm. Some few of the original settlers have survived the whole transitional period from lumbering to farming and have a better present economic status than they could have obtained in any other way.

At present the agriculture of the forest section is the outgrowth of various developments. Farm units consist of those totally on bottom land, those on combined bottom and upland cut-over land, and those entirely on cut-over land. Of these the bottom-land farms were, and to a large extent remain, self-sufficing and self-sustaining. The farmers on combined types of land naturally would be less independent, but they profited more by the lumbering industry. It is questionable whether farming on the upland cut-over land could ever have survived and developed had it not been for the assistance of outside employment and the capital obtained from repeated labor turn-over. The larger number of abandoned farmsteads are in such sections.

It is equally unprofitable to clear most of this cut-over land at the current price of labor. But if a farmer can clear his land at such times as he would be otherwise unemployed, he can afford to use his own labor to obtain what would otherwise have to be obtained at the expense of capital. Considerable revenue can also be obtained by cutting and selling unmerchantable timber as firewood.

There is little incentive for clearing except as a farmer finds he has insufficient cleared land to constitute an economic farm unit. He must either increase his cleared area or supplement his income from other sources. It is also impossible for him to dispose of a small clearing to advantage.

The factors that caused failures and disappointments in the past are equally potent at present. Through experience and assistance of the Agricultural Extension Service, the farmers are learning how to cope with their problems. The toxicity of resinous materials from the coniferous forest is largely overcome in the clearing operations and cultivation practices before seeding. It has been learned what mineral constituents are lacking in the soils, and these and the deficiencies of organic matter and nitrogen are supplied or built up by proper crop rotation with legumes.

The unprofitable system of continuous cropping to wheat and timothy has in general given place to a more remunerative and practical agriculture. Likewise, farming methods which are applicable to these soils and not dominated by outgrowth from practices in the adjacent prairies are becoming more generally adopted.

The present agriculture consists chiefly of growing subsistence crops based on alfalfa as a hay crop and sweetclover as a pasture crop. These crops add both organic matter and nitrogen, in which elements the forest soils are deficient, and they also provide the nucleus for a livestock industry through which to market the surplus produce. Potatoes and grains usually follow hay crops in the rotation. Dairying has proved the most desirable type of livestock industry, because of the available pasture in uncleared cut-over land. In addition, small flocks of sheep or some hogs or poultry are profitable.

The light-colored forested soils represent four distinct soil series. Though they are of similar surface color and texture they have developed certain definite characteristics, mainly because of topographic position and related climatic and vegetative influences.

On the lower lying areas, in which the relief ranges from almost flat or undulating to rolling, the soil materials have been accumulated and weathered in the most favorable position for soil development. Here the Santa soils have developed. From the point of view of soil depth and relief these soils are the most promising agricultural soils of the cut-over lands, though the subsoil is compact, tough, and not particularly favorable. Owing to the uniformity of texture which exists throughout the light-colored forest soils, the silt loam type only, with an outwash phase, is developed.

With increasing steepness of slope and in the hilly, steep sections, conditions have been less favorable, owing principally to erosion which has left the materials in less stable condition for soil development. Here a soil is developed which differs from the Santa soils in character of subsoil, is more shallow over the bedrock substratum, and contains small disintegrating angular fragments of parent rock. This is Benewah silt loam.

On the increasingly steeper slopes or where the decrease in vegetation has allowed more active erosion, the soil mantle over bedrock is comparatively thin and gravelly, and profile development is more or less lacking. The Huckleberry soils are developed here. A silt loam, with a red-subsoil phase, is mapped.

The Benewah and Huckleberry soils occupy areas, marginal to areas of rough mountainous land, which are predominantly of steeper slope and rougher relief than typical, more shallow, more inaccessible, and mainly nonagricultural. However, much of the hilly and mountainous territory is smoothly rounded and heavily forested, and the soil materials are stabilized and protected against severe erosion.

On those embayments of the basalt plateau extending into this section, where the basalt was exposed and weathered but not severely eroded, the Underwood soil has developed. Over much of the forested section it occurs in long narrow bodies along the breaks between the upland and the deeply dissected stream valleys. However, the largest of the more continuous areas lies in the east-central part of the county.

Santa silt loam.—Santa silt loam is the most important light-colored forest soil in extent, present agricultural development, and future agricultural possibilities. It occupies 76.4 square miles in more or less continuous bodies adjacent to the major stream valleys. It is the most accessible of the dominant forest soils, and in most

places the relief is favorable for agriculture. This soil occupies elevated or benchlike plateau areas high above the stream valleys. Owing to erosion, the surface relief ranges from comparatively flat and undulating to rolling and in many places hilly.

Surface drainage is well developed, as the uniformly fine texture of the surface soil makes it very retentive of moisture. The chemical reaction of the surface soil is slightly acid.

The surface soil is of light-brown, light yellowish-brown, or pale-yellow color, except in burned or cultivated areas and less densely wooded sections where it is decidedly more gray. The gray tint is more pronounced and continuous toward the prairie section and has probably been influenced by the grass and deciduous-brush growth. In average virgin development this soil is covered by a light-brown loose fluffy floury silty material which seems to vary in thickness with the density of the timber cover. In densely covered sections the material may exceed a foot in thickness, diminishing to negligible quantities in the open yellow-pine type of forest.

Beneath this material is a firmer, though friable and mellow, silt loam layer which continues to an average depth of about 19 inches. It is of light yellowish-brown or somewhat gray color, the gray becoming more pronounced with depth. Underlying this is a definite 6-inch layer of very light gray silty material having a high content of very fine sand. When dry this material is rather hard and compact, but it breaks down or powders with pressure. This material, in turn, is underlain very abruptly by slightly reddish brown clay or clay loam, which is tough and resistant (pl. 2, *B*). Angular breakages occur, along which are dark-brown organic coatings. Below a depth of 5 feet the material is of similar texture, more friable, lighter brown in color, and lacks the angular breakage.

Most of the land has been logged and is in second-growth timber. It is classed as cut-over land. Only a very small proportion is cleared and cultivated, though much of the land is held in farm units in association with the cleared areas and is used for grazing.

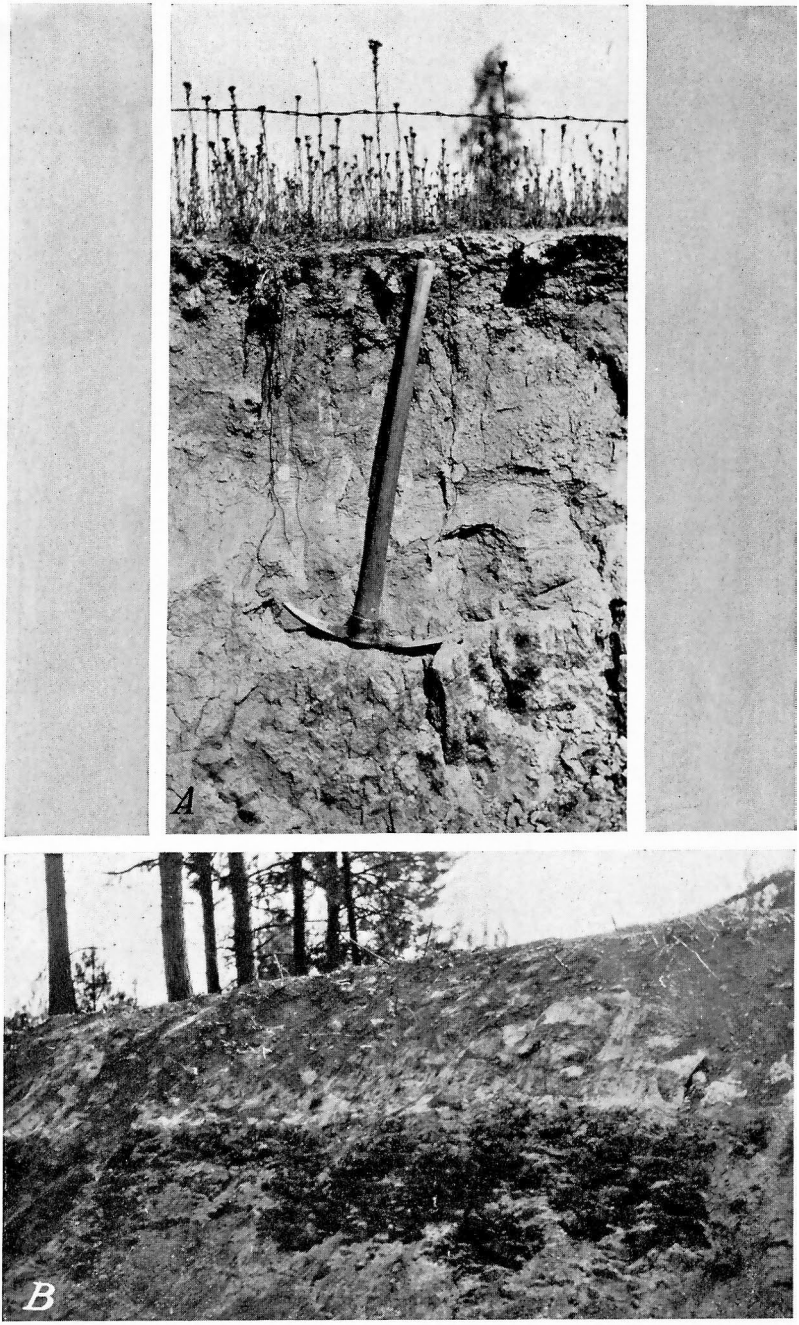
The present agriculture on this soil, as well as that on all the cut-over land, is based on alfalfa as a hay crop and sweetclover as a pasture crop. These crops supply and build up both the nitrogen and organic-matter deficiencies in these soils.

Wheat, oats, barley, and potatoes are grown in rotation with alfalfa and sweetclover. The hay and pasture are used for the farm livestock.

Alfalfa yields from 1½ to 2½ tons an acre, wheat yields average about 25 bushels, oats yield from 35 to 50 bushels, barley from 25 to 35 bushels, and potatoes from 50 to 80 sacks.

Texturally this soil is very uniform throughout the county, but some variations occur in the profile, which are due mainly to topographic position, and moisture has been the dominating influence. In sections 30, 31, and 32 of T. 45 N., R. 1 W., the soil profile is decidedly gray, and the outstanding horizons of the typical profile are obscured. This area is in general flat, and the variation is probably caused by excessive moisture. Along Emerald, Willow, Carpenter, and Santa Creeks are areas of meadow which merge almost imperceptibly with the upland timber soils. Adjacent to these, transitional areas of Santa silt loam have been subjected to excessive moisture

Freshly developed incipient gully erosion on Palouse silt loam. The dark-colored parallel streaks on the steep



A, Profile of Latah silty clay loam. Pick rests on top of the tough columnar solonetz horizon. *B*, Fresh highway cut in Santa silt loam near Plummer, showing characteristic profile with gray siliceous layer abruptly underlain by heavy-textured tough columnar material.

and have supported a growth of grass and deciduous underbrush. The result has been a changed profile, in which the surface soil is decidedly brown and the subsoil gray and mottled. But for the small extent and occurrence in marginal areas, this soil would have been classified and mapped as a different soil.

Santa silt loam, outwash phase.—The outwash phase of Santa silt loam occurs along St. Maries River, principally near St. Maries. It is developed on uniformly textured material which has been superimposed on talus slopes along the basalt escarpments. It may have had its origin in part from outwash materials from the benches or may have been blown up from the river channel. It is highly micaceous. The surface relief ranges from rolling to hilly.

The soil has a youthful profile, in which the more mature profile of typical Santa silt loam is suggested. The surface soil is of similar texture and color as that of the typical soil, but the definite light-gray layer and the underlying tough resistant clay loam layer are lacking in the subsoil. The subsoil is friable silty clay loam, in which only a suggestion of vertical breakage and some colloidal coating are noticeable.

This is not an extensive soil. It is favorably located in relation to St. Maries and nearby roads, and practically all the land has been cleared. From one-third to one-half is in crops. Yields and crops are similar to those on the typical soil.

Benewah silt loam.—Among the light-colored forest soils, Benewah silt loam ranks next in importance to Santa silt loam. It has a similar wide distribution but is less extensive, comprising 56.9 square miles. It is less favorably located as to accessibility and surface relief. In a few large continuous areas the surface relief is somewhat comparable to that of the Santa soil, but for the greater part it is steeply rolling, hilly, or steep. Drainage ranges from good to excessive, and, were it not for the forest cover, the land would be severely eroded, especially in areas where there has been total denudation by fire or clearing and farming operations.

This soil has the same light-brown light floury silt loam surface covering that is on the Santa soil, and it is equally variable in thickness. Beneath this and continuing to a depth of about 21 inches is light-brown or pale yellowish-brown crumbly silty loam which becomes more gray, heavier in texture, and more compact toward the bottom of the layer. This material is gritty with small decaying angular fragments of parent rock. At a depth ranging from 12 to 26 inches the material becomes light-gray heavy silt loam, but the gray layer is not so definitely developed as in the Santa soil. Below this is the subsoil which continues to the bedrock stratum as reddish-brown silty clay loam or clay loam slightly mottled with gray and dark-colored stains. The quantity of gritty gravel increases with depth, and the underlying parent quartzite and argillite substratum occurs, in most places, at a depth of about 5 feet. In the more deeply weathered areas the lower weathered soil material is somewhat gray and of fine sandy texture. The surface soil and deeper subsoil are slightly acid.

Marked variations from the typical soil occur in two places, one in the higher lying territory adjacent to the prairies, where the soil has been subjected to grass and deciduous-brush cover. Here the

surface soil is definitely darker and the subsoil more red. Another variation occurs in the western half of T. 45 N., R. 1 W., especially in sections 17, 20, 21, 28, and 29. This variation is within an area occupied mainly by Underwood soils developed from basalt, and it occurs at slightly higher elevations than those soils. The soil blends almost imperceptibly with the Underwood soils but has a profile development that more nearly resembles that of the Benewah soils, and micaceous material is discernible in the soil material. Although the soil material is so deeply weathered that its origin is not directly traceable to the parent materials of the Benewah soil, it is assumed that such is its origin. Factors which substantiate this are the presence of mica, the higher lying position, which is higher than any elevation attained by the basalt flow in any part of the county, and the more youthful profile of the Underwood soils developed on the resistant basalt within the same area. In this variation the light-brown light fluffy silty layer is about a foot thick. Beneath this the material is mottled grayish-brown and red loam which continues to a depth of about 24 inches where the reddish-brown color dominates, the gray color being due more to mottling. The material in this layer is clay loam. Below a depth of 40 inches the material is a definitely reddish-brown clay loam, in which there is a minor gray mottling, together with some dark-colored colloidal stains.

Most of the Benewah soil occupies areas that have been logged and are now in second-growth timber. Very little of the land is farmed, because of its general inaccessibility and because its steep, broken relief renders it generally unfavorable for extensive cultivation. Where farmed, if planted to similar crops, the yields are about the same as on the Santa soil.

This is a marginal soil, on which agricultural development should not be encouraged, except in places where the relief is favorable, as surface relief, rather than soil depth, is the limiting factor. The greater part of the land is best suited for reforestation.

Huckleberry silt loam.—Huckleberry silt loam is a soil, in which great variation in the depth of weathered soil material occurs.

The virgin soil has the same light yellowish-brown light floury silty material over the surface that is present on the other forest soils, but in most places its maximum depth is about 6 inches. Underlying this, the soil material is light grayish-brown gravelly loam which is structurally firm but is friable. It contains a large quantity of subangular gravel of different sizes. At a depth of about 16 inches the disintegrating surface of the parent stratified fine-textured quartzitic or argillite bedrock substratum is reached. Under cultivation the silty surface layer disappears, and the surface soil becomes grayish-brown silt loam or loam, with a pronounced quantity of gravel on the surface.

This soil is of small extent, occupying only 6.5 square miles. It is widely scattered over the county in small areas. Most of the land has been logged, but only here and there have small areas been cleared for farming, and only a very small part of the cleared areas are now farmed. The crops grown and agricultural practices are the same as on other cut-over land. However, yields are lower than on the other soils.

The same agricultural limitations shown for the Benewah soil are applicable to this soil. The soil is slightly acid, similar to the Benewah soil.

Huckleberry silt loam, red-subsoil phase.—Huckleberry silt loam, red-subsoil phase, differs from typical Huckleberry silt loam in that it lacks the light-brown floury silty covering and in that it has a pronounced red subsoil. The surface soil is light grayish brown. The red subsoil color is inherited from the parent rock substratum which is red quartzite of crystalline structure. The subsoil is of heavier texture than that of typical Huckleberry silt loam. Subangular gravel and stone protrude through the surface soil in many places, especially in areas of thin soil along the stream courses and at the lower elevations. In such areas the stony material is well rounded, showing that it has been transported. In many places the weathered soil is thicker than in typical Huckleberry silt loam.

Soil of this phase covers a slightly larger area than the typical soil. Its principal occurrence is at the base of the mountainous area east of Tensed. A slightly larger area of this soil is farmed than of typical Huckleberry silt loam. This may be because the red-subsoil phase lies adjacent to the prairie soils.

Underwood silt loam.—Underwood silt loam is derived from basalt weathered in place, and it differs materially from the other forest soils. The surface soil, though consisting in part of similar light floury silt loam, has a decidedly red tint. It is of equally variable thickness. The succeeding layer is a uniformly colored rich reddish-brown or chocolate-brown loam which is friable and granular and contains a few fragments of basalt. Between depths of 30 and 42 inches the subsoil is slightly green, tinged with reddish brown, gritty clay loam with a high content of disintegrating basalt. Below this is the basalt substratum, the topmost part of which is more or less weathered.

This description is characteristic of the soil as it occurs in the largest continuous area in T. 45 N., R. 1 W. The surface relief ranges from undulating to rolling, and drainage is good. This area is heavily forested. Over other parts of the county, this soil occurs in scattered bodies as narrow rims along the breaks of the basalt plateau. Here the light surface material is lacking, as the land is sparsely timbered and is exposed to erosion. In such areas the shallow surface soil is rich reddish-brown gritty loam. Stony areas are numerous, and the bodies are associated with the barren scab-land areas.

The total area of Underwood silt loam is 13.4 square miles. Where utilized, the land is usually farmed in conjunction with the other forest soils. The more deeply weathered areas are comparatively fertile. This soil has slight acidity.

BOTTOM-LAND SOILS

Throughout the section of light-colored forest soils are a number of soils that have accumulated and developed in the immediate stream valleys. The soil materials are of comparatively recent deposition and varied origin. The soils have developed under conditions of insufficient or retarded drainage. The manner and character of

geologic deposition, drainage, and vegetation have left impressions on these soils, which are now distinguishing features.

Certain surface characteristics have become definitely established by the vegetative cover. Under the coniferous growth are light-colored soils, whereas under deciduous brush and grass growth are dark-colored soils.

In the light-colored soil group are two soils, Peone silt loam and a light-colored phase of Chamokane loam. The dark-colored soils include St. Joe very fine sandy loam, St. Joe loam, St. Joe fine sandy loam, Colville silty clay, Potlatch loam, and Chamokane loam. Peat is also included with the bottom-land soils.

The light-colored bottom-land soils occupy comparatively narrow strips along drainageways, though occasionally they broaden out considerably. This is especially true of the Peone soil because it occupies the flatter, less steeply sloping areas along the streams. The light-colored phase of Chamokane loam occupies higher lying areas where the stream flow is more rapid and the stream bottoms narrow. The subsoil of this soil is gravelly and porous, whereas that of the Peone soil is heavy and rather intractable.

Neither in extent nor agricultural development do these soils have any special significance. In their association with the farmed uplands lies their chief value. They are slightly acid.

The dark-colored soils of the bottoms cover a combined area of 23.1 square miles. They are widely scattered along the stream courses and have their largest developments along St. Joe River, St. Maries River, and the larger tributaries of these streams. These are comparatively poorly drained soils and have supported flourishing growths of reeds, rushes, water-loving grasses, and deciduous brush. Poor drainage and this vegetation have left definite marks on the profile. The soils are slightly acid.

The St. Joe and Colville soils are developed principally in the flood plains of St. Joe and St. Maries Rivers, Chamokane loam along the tributaries of these rivers, and Potlatch loam along the larger streams in the southeastern part of the county.

The St. Joe and Colville soils on the St. Joe bottoms originally lay but a few feet above the general lake levels. With the building of the Post Falls Dam (outside of the area), controlling the outlet of Coeur d'Alene Lake, the water became backed up so as to make a continuous water surface up to and including Benewah Lake. The sluggish-moving rivers became even more retarded than before, and now areas not diked are either subjected to a high water table or are completely submerged. The diked areas, which consist mainly of the St. Joe soils, are now protected from overflow and excessive water.

Other areas of these soils, especially the St. Joe, occur in the higher lying territory in the southeast part of the county. These areas are better drained. In this section also is the main occurrence of Potlatch loam which occupies the open grassy meadow areas principally. The Potlatch soil also occurs along Benewah Creek.

Chamokane loam is developed in small areas, principally along the smaller tributaries of the major streams. In deposition of soil material this soil is similar to Chamokane loam, light-colored phase, and in many places is continuous with that soil.

Peone silt loam.—The 6-inch surface layer of Peone silt loam is light grayish-brown or light brownish-gray silt loam. The succeeding layer is light-gray silty clay loam with some red iron staining. This material, which is friable but sticky and plastic when wet, continues to a depth of about 18 inches, where a lighter color is noticeable, the material is slightly gritty with fine sand, and the iron staining is more pronounced. At a depth of about 38 inches is rather compact and tough clay loam of duller gray or darker gray color which becomes light gray when the material is dry.

Chamokane loam, light-colored phase.—The profile of Chamokane loam, light-colored phase, is very simple. It consists of a 16-inch layer of gravelly loam of low organic-matter content and open permeable structure over a subsoil of stone, gravel, and sands. The color varies from light brown or light grayish brown to light brownish gray, according to degree of drainage.

St. Joe very fine sandy loam.—Of the St. Joe soils, the very fine sandy loam is the most extensive and important. It covers a total area of 5.6 square miles and constitutes a large part of the diked section of the county.

The 8-inch surface layer is dull grayish-brown highly micaceous very fine sandy loam becoming decidedly gray when dry. This material is highly organic and dries out very light in weight. In the succeeding 10 inches the color is a little duller grayish brown or brownish gray, and the material is firmer. The subsoil, to a depth of about 48 inches, is dull grayish dark-brown iron-stained silty loam which is slick and highly micaceous. In the lower part of the subsoil there is an increasing quantity of sand, and the color becomes yellowish brown, spotted and stained with rust red. The color becomes gray when the material is dry.

Considerable variation occurs in the profile of this soil. In the lower lying areas the soil material is darker and duller in color in many places, and it may have bandings of dark organic layers throughout. This variation occurs principally where the soil is associated with peat and Colville silty clay. There is considerable organic or peaty material on the surface of this soil. A large continuous area of such soil occurs in parts of sections 16, 17, 20, and 21 of T. 46 N., R. 2 W. The peaty layer is rapidly decomposing under constant cultivation.

On the undiked areas of this soil, wild hay, timothy, and reed canary grass are grown. Much of the land is pastured. Intensive agriculture is carried on in the diked areas. The cash crops are oats, potatoes, and vegetable and truck crops. Oat yields average about 80 or 90 bushels an acre. Potatoes yield from 80 to 125 sacks. Vegetable and truck crops are grown for local markets only. Timothy hay produces from 1 to 3 tons an acre, and alsike or red clover produces from 2 to 3 tons.

St. Joe fine sandy loam.—St. Joe fine sandy loam occurs principally in long narrow strips along St. Joe and St. Maries Rivers. Most areas of this soil lie higher than the associated soils, occupying stream-built leveelike positions. The land is better drained and in many areas is the only soil that can be cultivated. Its total extent is 5.1 square miles.

The surface soil is dull grayish-brown or light grayish-brown highly micaceous fine sandy loam about 14 inches thick. This material is very uniform in texture and has a slick or greasy feel when wet. The subsoil is light-brown or light yellowish-brown, becoming light-gray when dry, highly micaceous fine sandy loam with a high amount of rust-red spotting or mottling. The material is coarser in texture than the surface soil and of lower organic-matter accumulation. Less of this soil than of the very fine sandy loam is banded by layers of organic matter or gray materials in the subsoil, owing to its higher lying position and better drainage.

A very narrow area along St. Maries River between Fernwood and Old Soldier Creek consists of shallow soil material over gravel and stone. Owing to its small extent, it is included with St. Joe fine sandy loam in mapping.

That part of this soil which lies in the diked area in association with St. Joe loam is equally intensively farmed. Similar crops are grown, but the fine sandy loam seems favored for potatoes and vegetables.

St. Joe loam.—St. Joe loam occurs in the southeastern part of the county along St. Maries River, where it constitutes an area of less than 1 square mile. The soil materials in most places are more shallow than in the other St. Joe soils. Internal drainage is better, owing to the underlying open gravelly substratum.

In typical development this soil consists of dark grayish-brown mellow loam to a depth of about 10 inches, where it changes to slightly lighter colored loam having a more definite structure. Below a depth of 20 inches is a subsoil development of yellowish-brown sandy loam spotted or mottled with rust red. The materials are highly micaceous throughout.

Similar crops are grown as on the other St. Joe soils. However, as the surface is somewhat irregular and broken by old channels, the land is used mainly for hay and pasture.

Colville silty clay.—Colville silty clay covers a total area of 4.7 square miles, the greater part of which lies adjacent to Chatcolet and Coeur d'Alene Lakes. It is of marshy character and more or less submerged, varying with the lake level. Small bodies occur in depressed areas along St. Joe and St. Maries Rivers, and many of these are submerged the greater part of the year. The main value of this soil is for pasture and wild-hay land.

The topmost 6 inches of soil is brown or dark-brown peaty silty clay, in which the color is dominated by a heavy incorporation of organic matter. Underlying this the soil continues to a depth of about 20 inches as grayish-black or somewhat bluish black highly organic silty clay. Between depths of 20 and 40 inches the subsoil is dark-gray or gray clay loam containing small yellow and red iron mottlings or stainings. The subsoil below this depth continues as bluish-gray silty clay. This layer has a slightly alkaline reaction but does not effervesce with acid. The subsoil is plastic and compact.

Potlatch loam.—Potlatch loam is the principal soil of the open flat meadow areas in the southeastern part of the county. This soil dries out late in the spring and is used chiefly for pasture and wild hay. Some areas are planted to oats or quick-maturing crops.

The surface soil is brown or rather dark brown heavy fine-textured loam. The structure is crumbly or granular, in many places platy in the upper part. Between depths of 12 and 30 inches the soil material is grayish-brown silty clay loam mottled with rust-colored iron stains. It is gray or brownish gray when dry. The lower subsoil layer is of lighter gray color and of increasingly heavy texture. This soil differs from the St. Joe soils chiefly in that it is not micaceous, is less friable and permeable, and lacks the yellowish-brown subsoil.

Chamokane loam.—Chamokane loam has little economic importance and is very small in extent. The small bodies are widely scattered. This soil is similar to Chamokane loam, light-colored phase, but its position has been favorable for accumulation of a high content of organic matter, and it is of much darker color.

The surface soil is brown or dark-brown granular loam, in many places containing gravel. This layer is underlain, at a depth ranging from 10 to 30 inches, by dark-brown or grayish-brown somewhat heavier textured and more compact loam which is highly mottled with rust-colored iron stains. The material is gray when dry. The underlying material consists of gray water-washed sand, gravel, and stone.

Peat.—Peat areas occur only in the St. Joe River bottoms, where they occupy positions similar to those occupied by the Colville soil, and in many places they are associated with minor lakes. They are flooded until late in the season, except those parts in the diked section. Tules, sedges, and water-loving grasses are abundant, and the areas are utilized for wild hay and pasture.

The topmost 6 inches of material consist of dark rich-brown or dark chocolate-brown loose decomposed peat containing many partly decayed fibrous roots. The succeeding layer, to a depth of about 20 inches is duller dark-brown peat which is more decomposed and compressed than the material in the surface layer. The deeper peat is darker than that in the layers above. It is well decomposed but is penetrated by dark, tough, partly decomposed fibers and roots. Peat is slightly acid throughout.

This is the type of peat found on the so-called "big meadow" where most of the peat is very deep, but considerable variation occurs throughout the bottoms, especially in depth of the material.

The larger areas of peat in the diked area occur in the west end. Much of this peat is shallow and in many places is mixed with more thoroughly decomposed mucky materials. Timothy and oats are the principal crops grown.

NONAGRICULTURAL LAND

The nonagricultural parts of Benewah County are occupied mainly by rough mountainous land and scab land. Scab land is of very small extent, but rough mountainous land occupies about 500 square miles, or 63.5 percent of the total land area of the county.

Rough mountainous land.—Most of the rough mountainous land consists of mountain ridges, hills, buttes, steep mountain slopes, and escarpments. The whole territory is more or less covered with a coniferous growth of yellow pine, lodgepole pine, white pine, red fir, white fir, cedar, spruce, and hemlock. Much of this land has been

logged and is now in second growth of similar species. There are also areas that have been burned severely and are restocking to native species very slowly. Such areas now support a dense growth of willow principally, and severe erosion has resulted in many of them. A large part of the rough mountainous land lies within the St. Joe National Forest which remains principally in the virgin state.

The soils included in rough mountainous land have not been differentiated, because of their general nonagricultural relief, shallow and stony character, or general inaccessibility. They consist mainly of the Benewah and Huckleberry soils. Small areas within this general classification could be farmed if they were not so scattered or inaccessible. A comparatively large area lying in an unfavorable position in the watersheds of Canyon and Thorn Creeks is of this type. A few small flat open areas supporting a grass cover occur throughout this larger area. These, together with some of the contiguous smoother areas, might be farmed at some future time if they become accessible and economic conditions warrant.

The future of the rough mountainous land lies mainly in its possibility for production of timber under careful supervision, management, and planting where necessary.

These rough areas afford some grazing, especially in the more open places. There is not sufficient local livestock to utilize the pasture, and sheep from outside the county are brought in for summer grazing. This type of grazing within the St. Joe National Forest is under Government control.

Scab land.—Scab land areas occur along the breaks of the stream valleys which have been incised in the basalt, principally on southward-facing slopes. A very thin stony soil mantle of Underwood soil material may be developed or may be totally lacking. The areas are practically barren of vegetation, but in places they support scattered growths of yellow pine, lodgepole pine, brush, and grass. The land affords some grazing.

SOILS AND THEIR INTERPRETATION

Benewah County lies at the eastern edge of the Columbia Basin in a territory where physiographic relationships have had a marked influence on the environmental factors of soil development. It is an area in which, as in much of the western mountainous region, changes in elevation are correlated with and determine climatic changes within short distances.

The westward-facing slope of the rapidly ascending mountainous area of the Bitter Root Range is subjected to a precipitation which increases eastward and has a corresponding decrease in temperature. The extent to which these factors have dominated the vegetal covering is reflected in the grass cover of the smoother prairie section on the west, under a 20- to 25-inch annual rainfall, and the coniferous forest cover of the mountainous terrain where the average rainfall increases to well above 30 inches.

The prairie section comprises an outlying area of the extensive rolling to hilly Palouse country lying mainly to the southwestward, in which the soils are generally conceded to be of loessial origin.

Owing to the general silty texture of all the soils, it is not known to what extent this loessial material has affected the forest soils. However, the rolling prairie relief gives way to one of smoother erosional outwash relief at the base of the mountainous terrain, which is suggestive of different origin. The deeper substratum is composed of sedimentary and metamorphosed rocks, whereas that of the prairie is the basalt of the Columbia lava flow. This is also the transitional vegetative zone, where the prairie gives way to forest. The agencies that have caused the dominance of the vegetal cover in this transitional zone are very vague, as there are indications that both types of vegetation have invaded areas occupied by the other. The only true present correlation seems to be the invasion of the forest into the prairie along the more sharply cut stream courses, where erosion and moisture are probably the stimulating agents of tree growth. The northern slopes are also more frequently forest covered. Where the flatter valleys along stream courses invade the forest, the cover in most places is grass.

In this transitional area yellow pine in an open parklike growth, with a deciduous-brush and grass undergrowth, is the vegetal cover. The transitional belt is narrow, and the vegetation gives way eastward to a heavy growth of conifers of mixed species and little or no underbrush or grass.

In these regions of different vegetal cover, two soil areas differing in color have developed—dark-colored soils in the prairie section and light-colored soils in the forest section. The transitional area marks a zone of irregularly colored soils ranging from light to dark.

The soil areas, or zones, are represented by a number of individual soil series, each of which is in turn represented by one or more individual soil types and subordinate phases. Some of the soils are identical with, or are so closely similar to, previously recognized soils of the adjoining or associated soil surveys that they have been so correlated and have been given the same soil series name; others have for the first time been recognized as representing distinct soils, though soil material of similar character and development may have been included as undifferentiated variations or inclusions in some of the soil types and phases of the earlier surveys.

The science of soil classification and technic of soil mapping are of comparatively recent development. With progress in the more complete, extensive, and detailed study and mapping of the soils of this region, certain apparent conflicts in the classification and mapping of the soils of this survey with those of the adjoining earlier surveys have developed. These are noted, with reference to the soils involved, in the discussion which follows.

The general slope of the area of dark-colored upland soils is dominated by the underlying Columbia basalt substratum and is gently westward, so that the streams drain to the west. The surface relief is peculiar to the Palouse country, consisting of a rolling to hilly upland area resulting principally from the original loessial deposition and subsequent drainage influences. There is evidence of the influence of retarded stream cutting in the hard basalt in the deposition of alluvium in wide flat belts along the major streams which traverse the rolling uplands. The streams barely descend into the basalt within this area, but farther west they drop into narrow val-

leys and incised canyons. As the streams cut their way into the basalt, the channels in the flat bottoms became deeper and better drainage was developed. At present the upland soils range from well to excessively drained, but the flatter alluvial lands are subjected to frequent flooding in the early part of the season.

In the rolling upland prairie section, the Palouse soil has developed, in the flatter part along the streams, the Latah. These soils are both dark-colored soils of comparatively high organic-matter content, developed under a heavy grass cover. The Latah soil is darker because of the dense grass cover stimulated by excess moisture and an additional incorporation of organic matter washed from the upland. The profiles of the two soils are distinctly different.

The Palouse soil represents the normally developed dark-colored soil under prevailing conditions of climatic and vegetative environment and drainage. The eluviated zone is one in which there is a large incorporation of organic matter and distinct granulation. The horizon of concentration, or illuviation, is distinctly heavier in texture and has an accumulation of colloidal organic matter and sesquioxides. The structure is well developed. Below this solum is the loessial parent material. As developed in this county, the reaction of the whole profile is neutral and there is no trace of $CaCO_3$ accumulation, except in a very few local areas, where lenses of this material may occur. The Palouse soils of this county, however, represent a development marginal to the typical Palouse soils of the extensive and distinctive Palouse country on the west, which are developed under a rainfall ranging from slightly to decidedly lower, in which definite horizons or lenses of lime accumulation are much more frequent and, in their more western marginal areas, dominant.[5]

In a representative location in Benewah County, Palouse silt loam shows the following development: The 10-inch surface horizon (A_1) is dark-brown or dark dull-brown mellow and friable silt loam high in content of organic matter and fibrous grass roots. The material is slightly granular. Between depths of 10 and 20 inches (A_2) the material becomes dull-brown heavy silt loam or silty clay loam, in which an angular crumbly or granular structure is developed. Small pinlike perforations are discernible in the granules. At a depth of 20 inches the zone of accumulation (B_1) begins. To a depth of 40 inches the material is dull rich-brown clay loam which crumbles with pressure into small angular pieces that are slightly elongated horizontally. Along the larger breakages is slight grayish-white mottling or seaming. There are small pinlike perforations in this material, which have both brown and gray colloidal coatings. In mass the material exhibits a vertical or columnar breakage. The succeeding horizon (B_2), to a depth of 60 inches, is rich reddish-brown or tawny-yellow highly colloidal clay loam or clay with grayish infiltration in some fracture planes or centralized near them. The columnar breakages are more widely separated than in the horizon above, and many of them are marked by brown colloidal coating. The smaller angular pieces contain small perforations. Under this

[5] VAN DUYNE, C., MORTLOCK, H. C., HECK, A. F., and ALVORD, E. D. SOIL SURVEY OF SPOKANE COUNTY, WASHINGTON. U.S. Dept. Agr., Bur. Soils, Field Oper. 1917. Rpt. 19: 2155–2258, illus. 1923.

is the parent material (C) which consists of rather uniformly colored yellowish-brown silty clay loam, in which some minute mica flakes are discernible.

A small area of the terrace phase of Palouse silt loam joins with Caldwell silty clay loam of Kootenai County adjoining Benewah County on the north, the terrace phase of the Palouse soil in many places representing material transitional between the typical upland Palouse soils and the lower lying soils of the Caldwell and other stream-bottom soils.

The Latah soil is developed on silty materials transported from the upland loessial soil and deposited on flatter lying areas of the stream valleys, in places superimposed over earlier transported deeper lying partly obscured gravelly materials. These materials, however, are too deeply buried to be part of the soil profile. The material on which the profile is expressed is distinctly of fine-textured silty character. The flat relief suggests that in early development this soil was probably a wet flood plain, crossed by meandering channels. When the streams cut down sufficiently to develop better drainage, so that weathering and leaching could begin, there began an expression of profile. However, the development evidently went on under conditions of excessive moisture and salts, owing to periodic flooding, as the profile became gray and of distinct solonetzlike character. At present the reaction is slightly acid throughout.

The surface soil (A_1) is very dark dull grayish brown, becoming dark grayish black when wet. The immediate surface layer of high grass-root incorporation is slightly platy, and the rest of the layer has a slightly granular structure. Between depths of 10 and 20 inches the material (A_2) is rather dull gray, of heavier texture, and of crumbly structure. Pinlike channels are noticeable. Under this is a 6-inch layer (A_3) of material which is very light gray, silty, siliceous, and has some compaction but becomes loose and powdery with pressure. The upper subsoil layer (B_1) is very compact and tough, is heavy textured, and has a definite columnar or prismatic structure, breaking into fragments which are very angular and about 1 inch in diameter. The prisms are coated with dark-colored organic or colloidal materials, but the cores are yellowish gray or olive gray, with numerous pinlike perforations, black and brown lined. The tops of the columns are rounded. In the lower part of this horizon, which continues to a depth of about 46 inches, the prisms are larger and are less coated. Below this is a grayish-drab, white, and red-tinted iron-stained or mottled heavy-textured material (the C horizon).

Small areas of this soil join with Caldwell silt loam of the Kootenai County, Idaho, and the Spokane County, Wash., soil surveys. The Latah soil is closely related to the Caldwell soils, with which it was included in the earlier surveys, but it is now differentiated, owing to its more highly developed tough B horizon of solonetzlike structure. A few very small areas also join with Helmer loam of the earlier surveys. As these soils occupy minor narrow stream-valley areas, they were not differentiated in the less detailed mapping of the earlier surveys.

Associated with Palouse silt loam but developed mainly in the transitional vegetative zone already described is the Nez Perce soil.

The surface relief in general is flatter than that of the Palouse soil. The Nez Perce soil consists principally of areas or embayments of the prairie along the larger streams which penetrate into the mountainous section. Minor areas, however, most of them too small to be shown on the soil map, also occur throughout the Palouse soil areas, usually in local flat or depressed areas and on northward-facing slopes. In general it may be said that the surface soil is like that of Palouse silt loam and the subsoil like the light-colored timbered Santa silt loam. In this respect it has a solonetzlike profile, but no examination has yet been made to determine the presence of adsorbed sodium ions.

A thin 4- to 6-inch light-gray siliceous single-grained layer overlies a highly colloidal columnar or prismatic B horizon.

A small area of this transitional soil joins with Helmer silt loam of the Kootenai County survey, and a very small body joins with Palouse silt loam of the Spokane County survey, in which the Nez Perce soil was not identified.

The light-colored upland forest soils have a remarkably uniform silty texture and slight range of color, but they are predominantly light brown or pale yellowish brown. The forest cover is composed entirely of conifers with very little deciduous underbrush or grass, except in the western marginal areas, in which the forest is a little more open. These soils, unlike the prairie soils, contain very little organic matter, which accounts for their light color. The grass growth is incorporated mainly in the surface soil, and it is well distributed. Trees develop less organic matter in the soil because of the deep penetration of their roots, their scattered growth, and centralization in large units. Therefore, in accumulation of organic material, grass is much more effective. Furthermore, grasses are more effective in bringing up chemical bases than are trees, especially conifers, so that organic remains become base saturated and hence flocculated and tend to become incorporated in the soil material, especially in the surface layer. The organic remains from conifers contain very little base material, so that base regeneration is slow in the surface layer, and hence the organic matter becomes acid and dispersed, leaving light-colored soils, all of which are slightly acid.

On these soils, except in the most westerly section, there is a light, fluffy, floury, fine silty single-grained veneer, or layer, which is distinct from the underlying soil material and seems to have a thickness correlating with the density of the forest cover. Casual observation suggests that this material is highly organic, but analysis does not show excessive organic-matter content.

From the point of view of geological origin of soil materials, these soils may be divided into two groups, those derived from the Belt series of sedimentary and metamorphosed rocks and those from basalt. The Santa, Benewah, and Huckleberry soils belong to the former group, the Underwood to the latter.

Much of the Santa soil occupies positions on the basalt substratum of the invaded lava flow. It appears that this soil has in part developed on transported material which has a remarkably uniform silty texture, free from any gritty or gravelly materials. It is not believed to be wholly of loessial origin but is probably transported by both wind and water in erosion of the adjacent higher lying hills

and mountains. The typical erosion relief in relation to these higher lying areas suggests this. In places this material seems to grade imperceptibly into the weathered material of the basalt substratum, but a similar relation exists where the basalt is covered thinly with transported rounded gravel. Therefore, no final or definite genetic relationship is traceable to the basalt.

The Santa soils of this survey are related to, and represent some of the included variations of, the Helmer soils of the earlier surveys of Latah and Kootenai Counties, Idaho, and Spokane County, Wash., in which the tight heavy-textured layer is partly or completely developed. It is now believed that extensive areas of Helmer silt loam of Kootenai County conform better to the Santa soils which were recognized as representing a distinct series of soils only in the present survey of Benewah County.

The Benewah and Huckleberry soils lie wholly in the area occupied by the Belt series of rocks, and they still retain angular fragments of the parent rock throughout. The weathered materials from this substratum are very fine textured and silty and yellowish brown or buff, which suggest the origin of these soils. This substratum of Belt rocks consists chiefly of fine-textured sandstone and shale or slightly altered equivalents, quartzites, and hard argillites.

In this group of soils it is questionable what the profile characteristics of a mature soil would be. The Santa soil occupies the flatter upland part of the areas but seemingly has had the inhibiting factor of excessive moisture and salts at some time, so that a soil of solonetz characteristics has developed. The Benewah and Huckleberry soils have developed on the steeper slopes, where progressive erosion has obtained, and therefore are too unstable for maximum development. The Huckleberry soil occupies the steepest positions or those favorably exposed for erosion, has the thinnest solum, and is the least developed.

In average typical development the profile of Santa silt loam may be described as follows: An immediate surface veneer (A_1) extending to a depth of 6 inches, of light yellowish-brown or pale-yellow silty light single-grained loose fluffy floury material. The forest-debris layer is negligible. The next layer (A_2) is distinctly defined from the above as a more compact silt loam of definite structure and light yellowish-brown or pale-yellow color. Slight gray mottling occurs toward the bottom. Vertical and horizontal breakages are discernible, and the material is perforated with pinlike channels which are lined with brown and gray glossy or waxy material. The next horizon (A_3), which begins at a depth of 19 inches, is a distinct feature of this soil. It consists of a 6-inch layer of very light gray siliceous silt loam which is somewhat compacted but powders readily. A slight brown mottling is discernible, and the pinlike channels are lined with brown. This material rests abruptly on compact silty clay loam, clay loam, or clay of definite angular prismatic or columnar structure, the tops of the columns being rounded (B_1). The mass of the material is somewhat reddish brown or rich brown, but fissures and root channels are much stained with dark-brown organic vitreous coatings. Broken columns show pinlike perforations and larger solution chambers which are lined with gray. Below a depth of 60 inches the soil (C) continues as similar-textured but lighter brown material.

The structure of the horizon above is lacking, but the soil material contains some perforations which are lined with gray.

These soils of solonetzlike profile are in process of degradation. They are slightly acid throughout, and a podzolized ashy siliceous layer is developed above a highly colloidal B horizon. No soluble salts or $CaCO_3$ are present in any part of the solum or accumulated parent material. It is evident that these soils have been subjected to a leaching action for a long time, in which period all the saline salts have become leached out, and all attendant and subsequent alkalinity is gone. To what extent sodium remains in the colloidal complex of the B horizon is not known, but the deflocculated condition of the colloidal materials is still retained as a prismatic columnar tough plastic horizon of heavy texture.

In the development of the solonetzlike profile it is conceivable how these characteristics developed in seepy slopes and flat basin areas under the influence of collected and concentrated salts brought about by periodic or continuously excessive moisture. But under topographic conditions of most of these soils, correlating factors are not altogether conclusive. The Latah soil, and to some extent certain localized areas of the Palouse, are in a position for such development. This is not generally true of the Santa soil. The Santa and the Nez Perce soils have undulating or rolling surface relief, and the land is well drained. It cannot be assumed that the total area of these soils was seepy. Neither can it be assumed that accumulation of soils took place in flat or basinlike areas which later were eroded to a broken relief, because the solonetz profile extends consistently over all phases of the relief. The only variability occurring in the profile is more intense development and podzolization in the flatter and lower lying areas.

Under these topographic conditions, it would seem that if salts were the dominating factor in this profile development, these must have had origin in the parent material. To what extent the underlying basaltic substratum or parent loessial and sedimentary materials could supply these salts is not known.

The Benewah soil differs in several respects from the Santa. It occupies a territory of deeper cut relief of hills and steeper mountain slopes. The soil ranges from well to excessively drained, and, were it not for the protection of the dense forest cover, it would be severely eroded. Less stable conditions would not allow the profile development which has taken place. The substratum of Belt rock lies within the limit of the normally developed profile and is near enough to the surface to form an integral part of the soil. In the Santa soil this is true in only a few places, the substratum lying deeply buried. The Benewah soil is well sprinkled with fragmentary gravel throughout the profile. The profile is not one of well-developed solonetz characteristics as is the Santa, but it approaches a solonetz condition in places, and the different horizons show similarity of succession.

As developed in Benewah silt loam, there is a similar veneer (A_1) of light yellowish-brown or pale-yellow light loose floury silty material on the surface as in the Santa soil. From 8 to 16 inches (A_2) the material is light yellowish-brown or pale-yellow more compacted silty loam containing a good deal of very fine sand which is gritty

and gravelly with angular gravel. Below this there is a slight change to light yellowish-brown slightly heavier textured material (A_3) much mottled with gray and sprinkled with decaying rock fragments. This material breaks loose in clods which are perforated with pinlike channels lined with brown and gray. Between 21 and 25 inches (A_4) the material becomes predominantly light gray. It retains a structure similar to that of the overlying material, but the perforations are larger and more pronounced. Beneath this is the subsoil horizon (B) of compact reddish-brown silty clay loam or clay loam mottled with gray. The columnar or prismatic structure, together with the intense colloidal coating and mottling of the Santa soil, is lacking. Colloidal coating, however, increases with depth and carries into the decaying substratum at a depth ranging from about 4 to 5 feet.

A few small areas of Benewah silt loam join with areas of the Helmer and Moscow soils of the Kootenai and Spokane Counties surveys. They represent transitional materials which were included with the Helmer and the Moscow soils of the earlier surveys. A small area of Benewah silt loam was also included with the undifferentiated soil materials of rough mountainous land of the Latah County survey, adjoining Benewah County on the south.

In the heavier timbered and more favorable locations for soil development Underwood silt loam has a similar surface layer of light-textured silty floury material as the associated forest soils, but the color is reddish brown. At a depth of 1 foot the material is a more compact, rich reddish-brown heavy loam of granular structure, which crumbles readily with pressure. Root channels and perforations are present, but they are not coated. Here and there fragments of decaying basalt and some small organic or iron shotlike pellets occur. At a depth of about 30 inches is greenish-brown clay loam containing a large quantity of decaying basalt, in which soil structure is less well developed. The disintegrating surface of the consolidated basalt is reached at a depth of about 42 inches. As mapped in this survey a small area of this shallow soil joins with scab land of the Kootenai County survey, with which it merges.

The Peone soil occupies a position in association with the Santa soil, comparable to that of the Latah with the Palouse soil. The Peone soil, however, does not have solonetz characteristics. The only suggestion of such development is in the tough somewhat intractable subsoil. Any other definite color characteristics are obscured by the gray.

In table 4 are given the results of mechanical analyses of samples of several soils in Benewah County.

TABLE 4.—*Mechanical analyses of several soils from Benewah County, Idaho*

Soil type and sample no.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Palouse silt loam:								
541563	0–10	0.1	0.1	0.1	0.9	7.1	68.5	23.2
541564	10–20	.0	.1	.1	.9	6.7	61.8	30.4
541565	25–40	.0	.1	.1	.6	6.1	59.7	33.5
541566	40–60	.0	.3	.2	.5	5.8	61.0	32.1
541567	60+	.0	.1	.2	1.1	9.2	64.3	25.1
Nez Perce silt loam:								
541554	0–12	.0	.1	.2	1.5	8.2	63.2	26.7
541555	12–32	.0	.1	.3	1.5	7.5	64.6	25.9
541556	32–36	.0	.2	.3	1.8	8.3	68.7	20.8
541557	36–65	.0	.1	.2	.7	4.8	48.0	46.2
Santa silt loam:								
541522	0– 6	.4	.6	.5	1.4	8.4	70.0	18.6
541523	6–19	.3	.7	.4	1.4	8.3	67.8	21.1
541524	19–26	.4	1.3	.7	1.8	7.8	74.1	14.0
541525	26–60	.4	.6	.5	1.3	7.4	59.2	30.7
541526	60+	.4	.7	.6	1.6	9.3	59.0	28.5
Benewah silt loam:								
541531	0– 8	2.5	2.9	1.8	4.7	10.7	57.3	20.2
541532	8–16	2.4	2.3	1.4	3.2	9.7	60.1	21.0
541533	16–21	3.6	3.9	2.3	5.8	11.2	51.6	21.5
541534	21–26	3.1	3.7	2.3	5.9	11.3	52.6	21.0
541535	26+	1.7	3.5	2.5	5.4	9.7	48.2	29.1
Underwood silt loam:								
541518	0–14	3.0	6.2	3.6	5.1	8.9	51.7	21.4
541519	14–30	1.3	2.4	2.2	5.2	9.3	46.6	33.1
541520	30–42	1.5	4.0	3.1	6.1	6.6	35.4	43.2
541521	42+	1.0	6.8	4.9	7.8	11.8	44.6	23.2

The areas shown on the soil map as rough mountainous land include undifferentiated steep, rough, shallow, and stony soil materials, mainly of nonagricultural character, and they include and join with some similar materials of the adjoining Kootenai County survey, which were mapped in that county as Helmer silt loam and scab land.

Table 5 gives the pH value of samples of several layers of the more important and more extensive soils in Benewah County.

TABLE 5.—*pH determinations of samples of several soils in Benewah County, Idaho*

Sample no.	Soil type	Depth	pH	Sample no.	Soil type	Depth	pH
		Inches				*Inches*	
541518	Underwood silt loam	0–14	5.63	541554	Nez Perce silt loam	0–12	6.09
541519	do	14–30	5.80	541555	do	12–32	5.93
541520	do	30–42	5.80	541556	do	32–36	6.82
541521	do	42+	5.98	541557	do	36–65+	6.62
541522	Santa silt loam	0– 6	5.98	541563	Palouse silt loam	0–10	6.82
541523	do	6–19	5.57	541564	do	10–20	6.83
541524	do	19–26	5.63	541565	do	20–40	6.73
541525	do	26–60	5.42	541566	do	40–60	7.17
541526	do	60+	6.40	541567	do	60+	6.90
541531	Benewah silt loam	0– 8	6.75				
541532	do	8–16	6.32				
541533	do	16–21	6.15				
541534	do	21–26	6.25				
541535	do	26+	5.55				

Results of determinations of the moisture equivalents of the soils mapped in Benewah County, Idaho, are given in table 6. These determinations were made in the laboratories of the University of Idaho.

The moisture equivalent of a soil is the amount of moisture, expressed in percentage, that the soil will hold against a pressure 1,000 times that of gravity. When interpreted in terms of agriculture, it is usually considered that a soil with a moisture equivalent ranging from 20 to 35 percent is a soil in which dry farming is feasible.

TABLE 6.—*Moisture-equivalent determinations of soils in Benewah County, Idaho*

Sample no.	Soil type	Location	Depth	Moisture equivalent
			Inches	*Percent*
541501	Santa silt loam, outwash phase	½ mile southeast of St. Maries	0–12	31.7
541502	do	do	12–28	23.0
541503	do	do	28–60	26.4
541504	St. Joe fine sandy loam	½ mile north of St. Maries	0–14	24.5
541505	do	do	14–36	17.5
541506	do	do	36–70	26.5
541507	Colville silty clay	NW¼NW¼ sec. 2, T. 46 N., R. 3 W	0– 6	54.0
541508	do	do	6–20	60.0
541511	Peat	NW¼NE¼ sec. 13, T. 46 N., R. 3 W	0– 6	87.0
541512	do	do	6–20	76.6
541513	do	do	20–60	35.1
541514	St. Joe very fine sandy loam	NE¼SE¼ sec. 17, T. 46 N., R. 2 W	0– 8	40.6
541515	do	do	8–18	34.2
541516	do	do	18–48	38.7
541517	do	do	48–80	29.3
541518	Underwood silt loam	NW¼NE¼ sec. 32, T. 45 N., R. 1 W	0–14	31.7
541519	do	do	14–30	28.2
541520	do	do	30–42	30.6
541521	do	do	42+	38.6
541522	Santa silt loam	NE¼SE¼ sec. 6, T. 43 N., R. 2 W	0– 6	32.6
541523	do	do	6–19	29.8
541524	do	do	19–26	21.0
541525	do	do	26–60	26.2
541531	Benewah silt loam	NE¼NE¼ sec. 31, T. 46 N., R. 3 W	0– 8	29.2
541532	do	do	8–16	28.0
541533	do	do	16–21	23.8
541534	do	do	21–26	20.4
541535	do	do	26+	22.1
541536	Chamokane loam	SE¼NW¼ sec. 15, T. 46 N., R. 1 W	0–10	37.7
541537	do	do	10–30	33.8
541538	do	do	30+	10.1
541539	Chamokane loam, light-colored phase.	NW¼NE¼ sec. 15, T. 46 N., R. 1 W	0–16	20.5
541541	Huckleberry silt loam	NE¼SE¼ sec. 23, T. 46 N., R. 2 W	0– 6	31.9
541542	do	do	6–16	22.1
541543	do	do	16+	19.4
541544	Potlatch loam	NW¼NW¼ sec. 5, T. 43 N., R. 2 W	0–12	31.9
541545	do	do	12–30	27.5
541546	do	do	30–60	25.6
541547	St. Joe loam	NE¼NE¼ sec. 16, T. 43 N., R. 1 E	0–10	26.7
541548	do	do	10–20	24.9
541549	do	do	20–70	21.6
541551	Peone silt loam	NW¼SW¼ sec. 15, T. 43 N., R. 4 W	6–18	27.6
541552	do	do	18–38	30.3
541553	do	do	38–60	23.8
541558	Latah silty clay loam	NE¼SE¼ sec. 27, T. 45 N., R. 5 W	0–10	31.2
541559	do	do	10–20	29.4
541560	do	do	20–28	29.9
541561	do	do	28–46	33.9
541562	do	do	46–70	25.7
541563	Palouse silt loam	NE¼NW¼ sec. 29, T. 45 N., R. 5 W	0– 8	26.8
541564	do	do	8–20	25.6
541565	do	do	20–40	25.8
541566	do	do	40–60	25.7

It is evident that all these soils are satisfactory except Chamokane loam which seems to be droughty in the lower horizon, and Chamokane loam, light-colored phase, which also appears to be only fairly retentive of moisture. Colville silty clay and the peat show very high moisture equivalents. This is indicative of their high organic-matter content.

Examination of the data for individual soils shows rather interesting textural relationships between the different horizons. In Santa silt loam, the podzolized character of the third horizon is shown by the low moisture equivalent. This horizon is underlain by a much heavier horizon which is indicated by the higher moisture equivalent. Similar relationships might be pointed out in other soils, but this example serves to illustrate the usefulness of the moisture-equivalent data in characterizing soil texture.

SUMMARY

Benewah County is in the "Panhandle" section of northern Idaho. One tenth of the county consists of open rolling or hilly prairie of the "Palouse country." The rest is a conifer-forested semimountainous or mountainous area interspersed with valleys. The rise in elevation is eastward, with a corresponding increase in precipitation and decrease in temperature. The precipitation increases from 20 inches in the western part to more than 30 inches in the eastern part. The mean annual temperature at St. Maries, the county seat, is 47.2° F.

The inhabitants are engaged in agriculture and lumbering. The soils consist of dark-colored upland soils, light-colored forest soils, and bottom-land soils of variable character.

Almost all the area occupied by the dark-colored upland soils is farmed, almost exclusively for the production of wheat. These soils are of silty loessial origin and include the Palouse, Nez Perce, and Latah soils.

The forest soils have been logged to a large extent. At least 70 percent of the forested section is unsuitable for agriculture. Small areas of cleared cut-over lands and bottom lands are being farmed. A semidiversified type of agriculture, including livestock raising, is carried on.

The upland forest soils are in general of silty texture and light color. The Santa, Benewah, and Huckleberry soils are developed on materials derived from the Belt series of rocks. The Underwood soil is developed on basalt material.

The bottom soils of the forest section are generally fine textured, of varied origin, and poorly drained. They include the light-colored Peone soil, a light-colored phase of the Chamokane soil, and a group of darker colored soils—the St. Joe, Colville, Potlach, and Chamokane soils. There are also a few areas of peat.

○

Authority for printing soil survey reports in this form is carried in Public Act No. 269, Seventy-second Congress, second session, making appropriations for the Department of Agriculture, as follows:

There shall be printed, as soon as the manuscript can be prepared with the necessary maps and illustrations to accompany it, a report on each soil area surveyed by the Bureau of Chemistry and Soils, Department of Agriculture, in the form of advance sheets bound in paper covers, of which not more than 250 copies shall be for the use of each Senator from the State and not more than 1,000 copies for the use of each Representative for the congressional district or districts in which a survey is made, the actual number to be determined on inquiry by the Secretary of Agriculture made to the aforesaid Senators and Representatives, and as many copies for the use of the Department of Agriculture as in the judgment of the Secretary of Agriculture are deemed necessary.

Areas surveyed in Idaho, shown by shading. Detailed surveys shown by northeast-southwest hatching.

U. S. GOVERNMENT PRINTING OFFICE: 1938

Accessibility Statement

This document is not accessible by screen-reader software. The U.S. Department of Agriculture is committed to making its electronic and information technologies accessible to individuals with disabilities by meeting or exceeding the requirements of Section 508 of the Rehabilitation Act (29 U.S.C. 794d), as amended in 1998. Section 508 is a federal law that requires agencies to provide individuals with disabilities equal access to electronic information and data comparable to those who do not have disabilities, unless an undue burden would be imposed on the agency. The Section 508 standards are the technical requirements and criteria that are used to measure conformance within this law. More information on Section 508 and the technical standards can be found at www.section508.gov.

If you require assistance or wish to report an issue related to the accessibility of any content on this website, please email Section508@oc.usda.gov. If applicable, please include the web address or URL and the specific problems you have encountered. You may also contact a representative from the USDA Section 508 Coordination Team.

Nondiscrimination Statement

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the

Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

(1) mail: U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
HENRY G. KNIGHT, CHIEF
A. G. McCALL, CHIEF, SOIL INVESTIGATIONS
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

SOIL MAP
BENEWAH COUNTY
IDAHO

UNIVERSITY OF IDAHO
COLLEGE OF AGRICULTURE AND
AGRICULTURAL EXPERIMENT STATION
E. J. IDDINGS, DEAN AND DIRECTOR
G. R. McDOLE, IN CHARGE SOIL SURVEY

Macy H. Lapham, Inspector, District 5.
Soils surveyed by E. N. Poulson, U. S. Department of Agriculture, in charge, and K. B. Platt, University of Idaho.

LITHO EASTERN OFFSET INC. BALTO.

Field Operations
Bureau of Chemistry and Soils
1930